Hydroacoustic Evaluation of Adult Steelhead Fallback and Kelt Passage at The Dalles Dam in 2008/2009 and 2009/2010

Fenton Khan, Gary Johnson, and Mark Weiland

Pacific Northwest National Laboratory

Pacific Northwest
NATIONAL LABORATORY

Methods

- Fixed location hydroacoustics technology.
  - Transducers at each of the 22 powerhouse main turbine units.
  - Transducers at each open sluice entrance: SL 1-2, 1-3, 18-1 and 18-2.
  - Three study periods:
    - Period 1: November 1 – December 15, 2009 for the fall/winter sluiceway and turbine study;
    - Period 2: December 16, 2009 – March 7, 2010 for the turbine only study;
    - Period 3: March 8 – April 10, 2010 for the spring sluiceway and turbine study. *Note: Oil spill cleanup at sluice outfall delayed the start of the study to March 8*
- Data collected 24h/d for the entire study (Nov 1, 2009 – April 10, 2010).

Pacific Northwest
NATIONAL LABORATORY

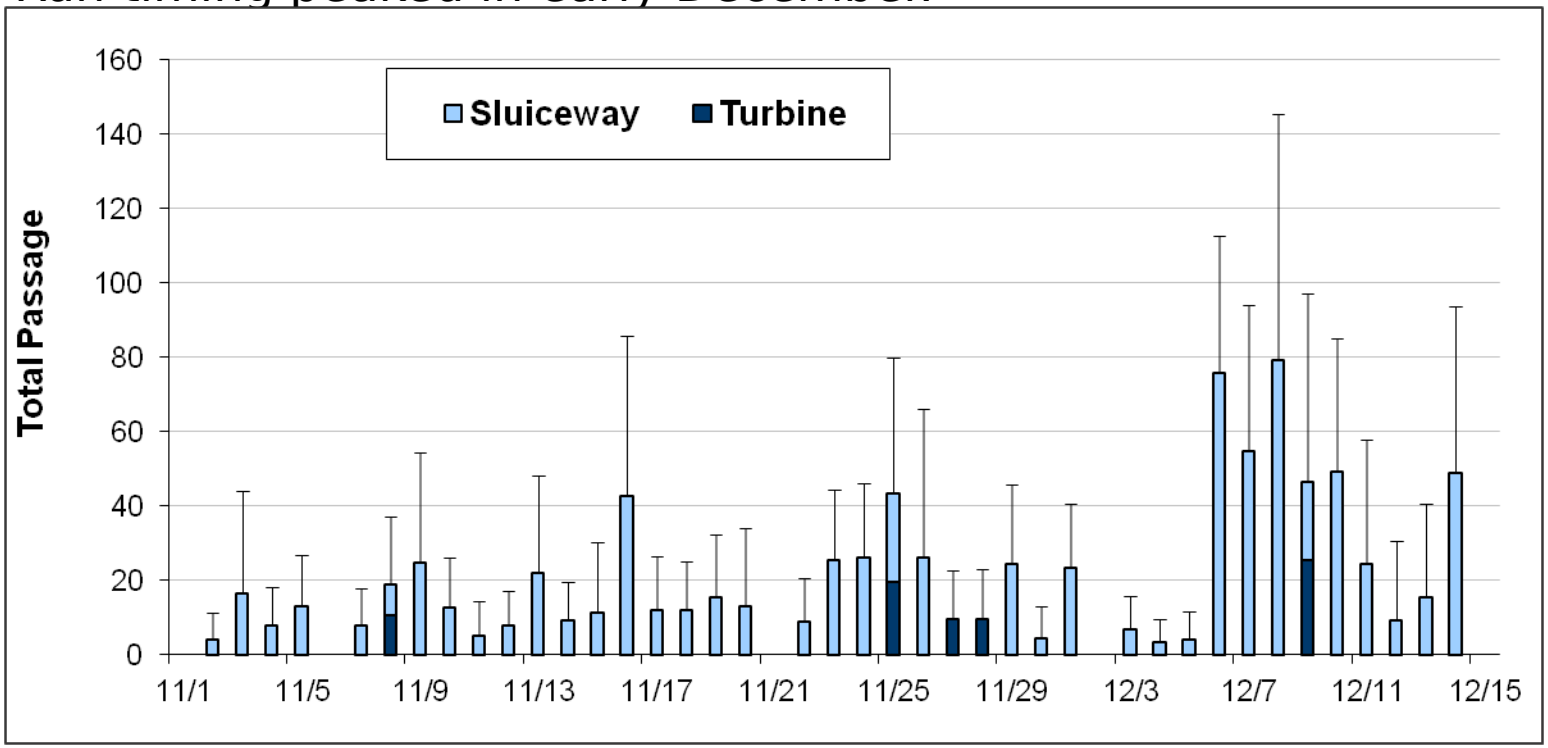
Results: Period 1

Fall/Winter: Sluiceway and Turbines (November 1 – December 15, 2009)

Pacific Northwest
NATIONAL LABORATORY

Passage Rates and Run Timing

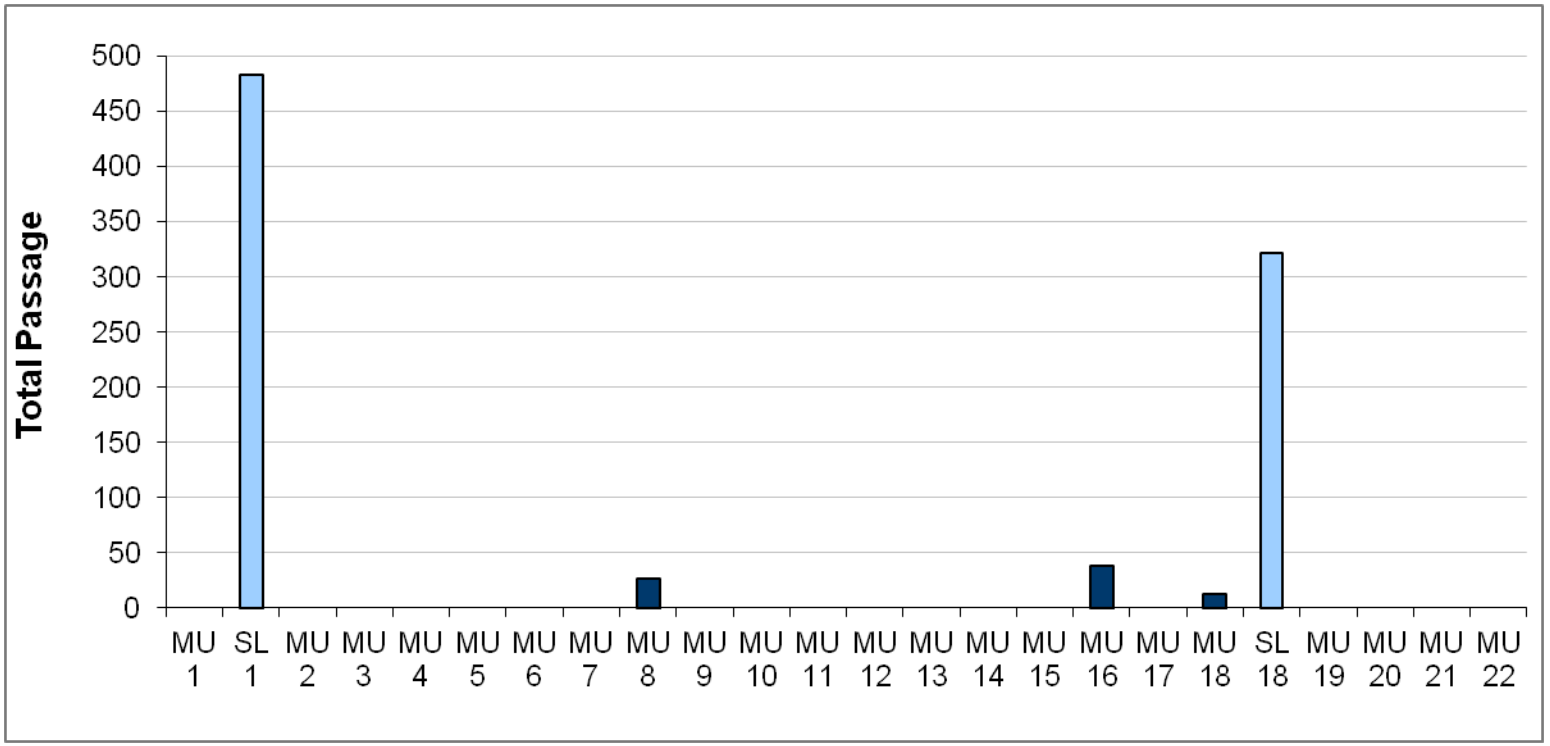
- A total of 879 ±165 (95% confidence interval) adult steelhead-size targets passed through the turbines and operating sluice entrances. Daily average of 20 targets.
- 804 (92%) passed through the sluiceway and 75 passed through the PH.
- Run timing peaked in early December.



Pacific Northwest
NATIONAL LABORATORY

Horizontal Distribution

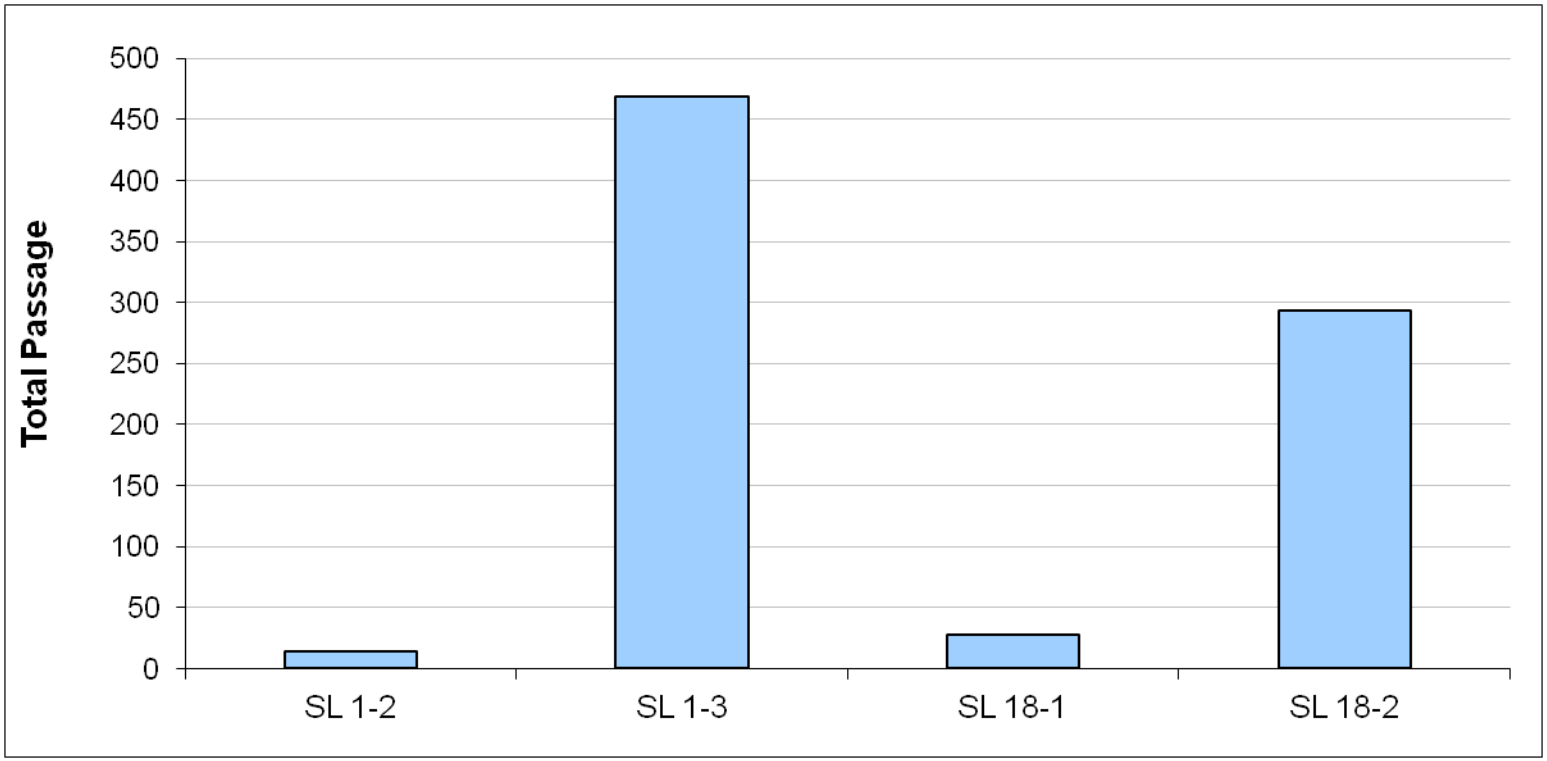
- Total passage was highest at SL 1. SL 18 had the second highest number of fish passing. A small number of fish passed through PH turbines 8, 16 and 18.



Pacific Northwest
NATIONAL LABORATORY

Horizontal Distribution – Sluice Entrances

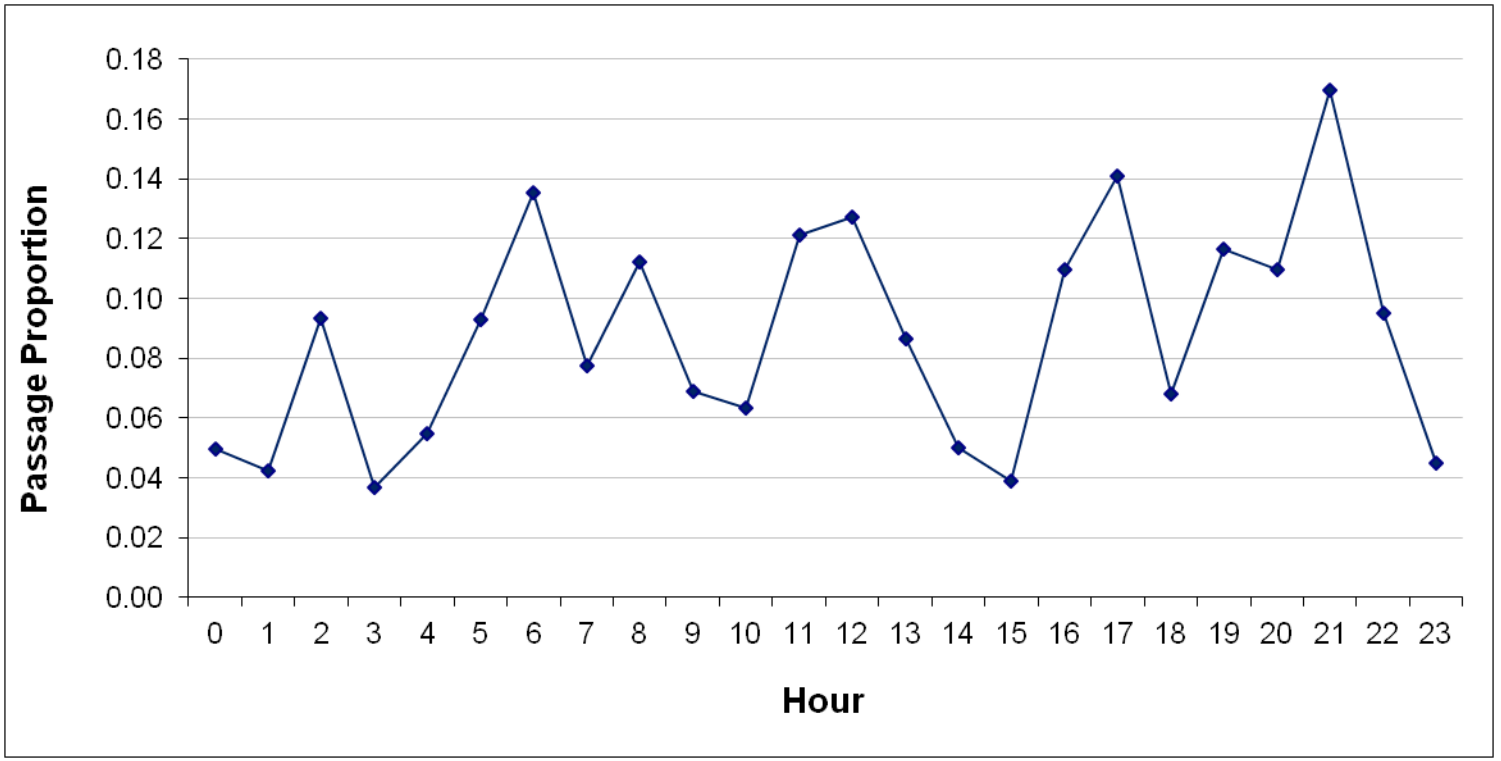
- For individual sluice entrances, SL 1-3 passed the highest number of fish (469 targets), followed by SL 18-2 (293). Fewer than 50 targets passed through SL 1-2, and 18-1.



Pacific Northwest
NATIONAL LABORATORY

Diel Distribution

- Diel distribution of overwintering steelhead was highly variable and had no consistent pattern.



Pacific Northwest
NATIONAL LABORATORY

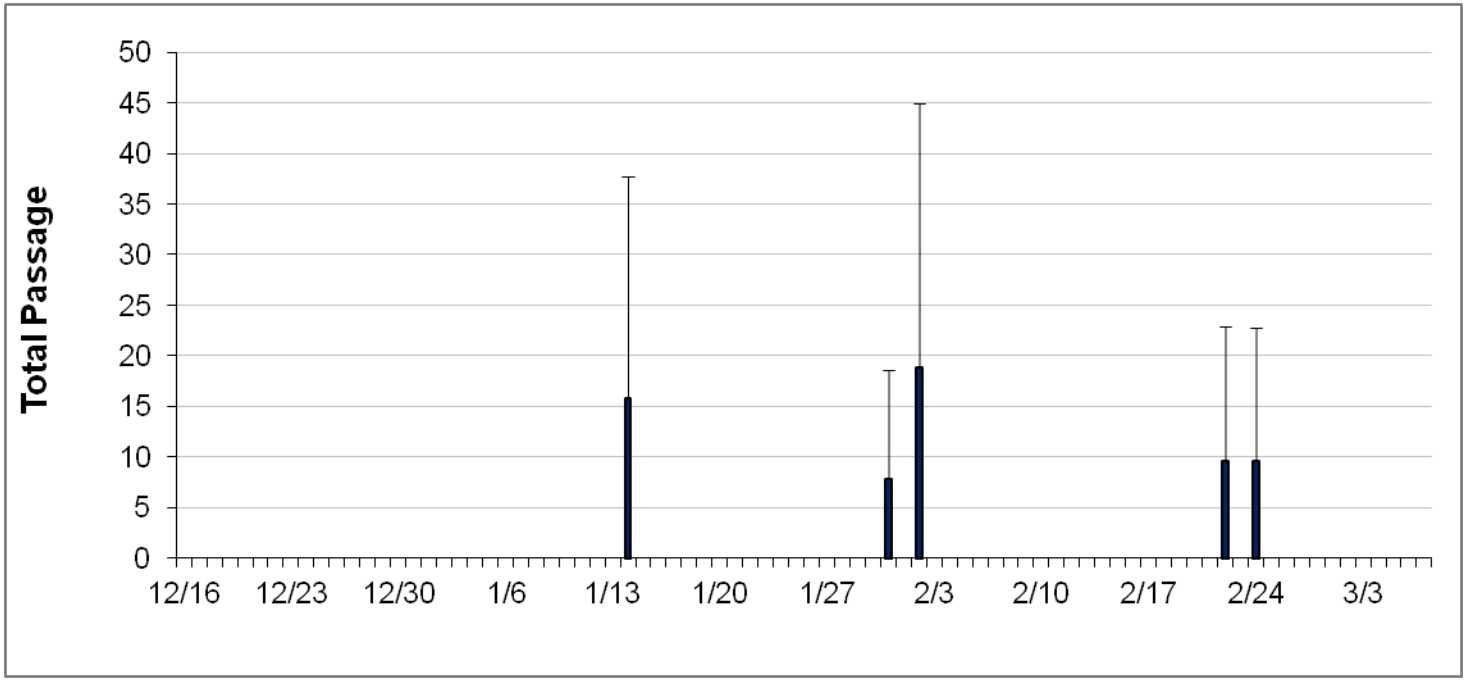
Results: Period 2

Winter: Turbines Only (December 16, 2009 – March 7, 2010)

Pacific Northwest
NATIONAL LABORATORY

Passage Rates and Run Timing

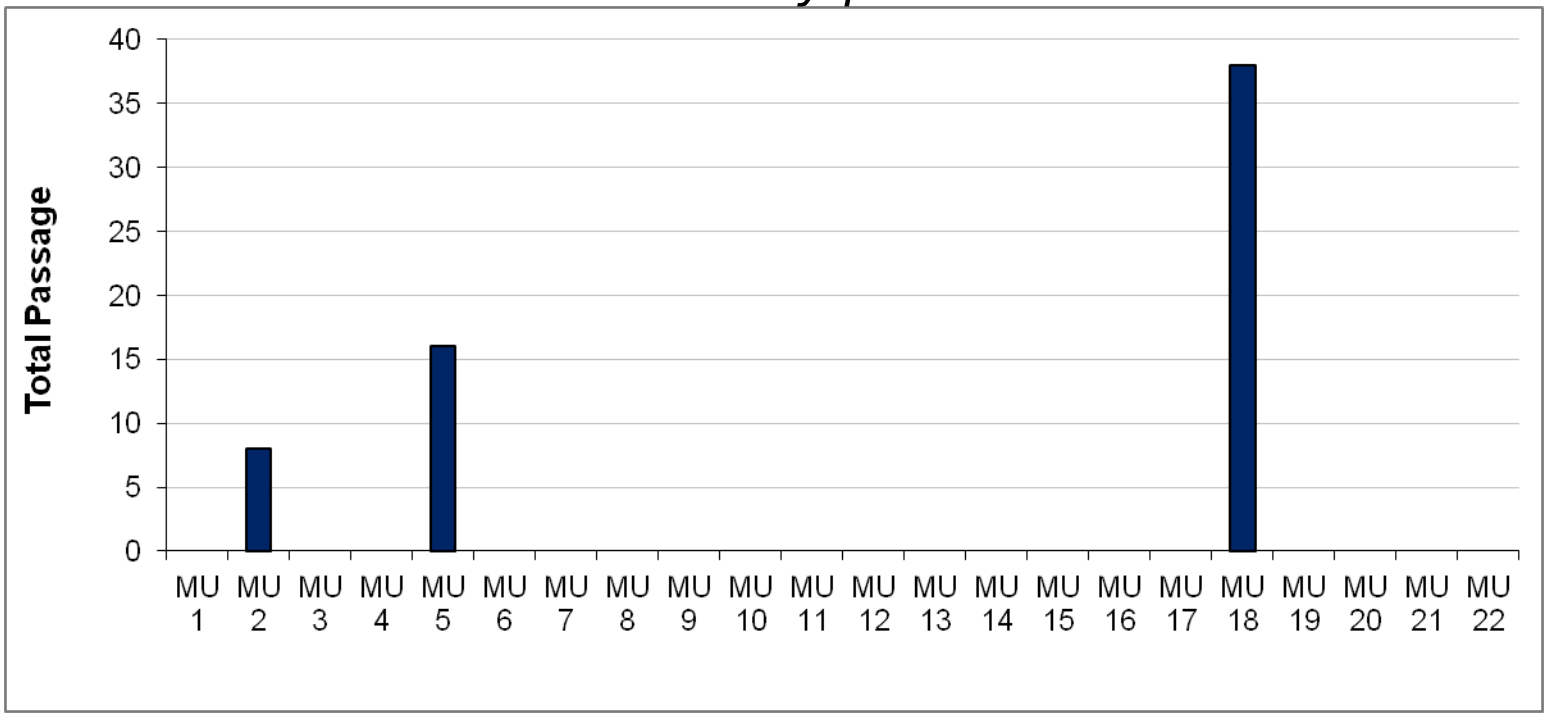
- A total of 62 ± 40 (95% CI) adult size steelhead targets passed through the powerhouse intakes during the 82-day study period.
- Fish were detected passing the turbines on January 14 and 31 and February 2, 22, and 24.



Pacific Northwest
NATIONAL LABORATORY

Horizontal Distribution

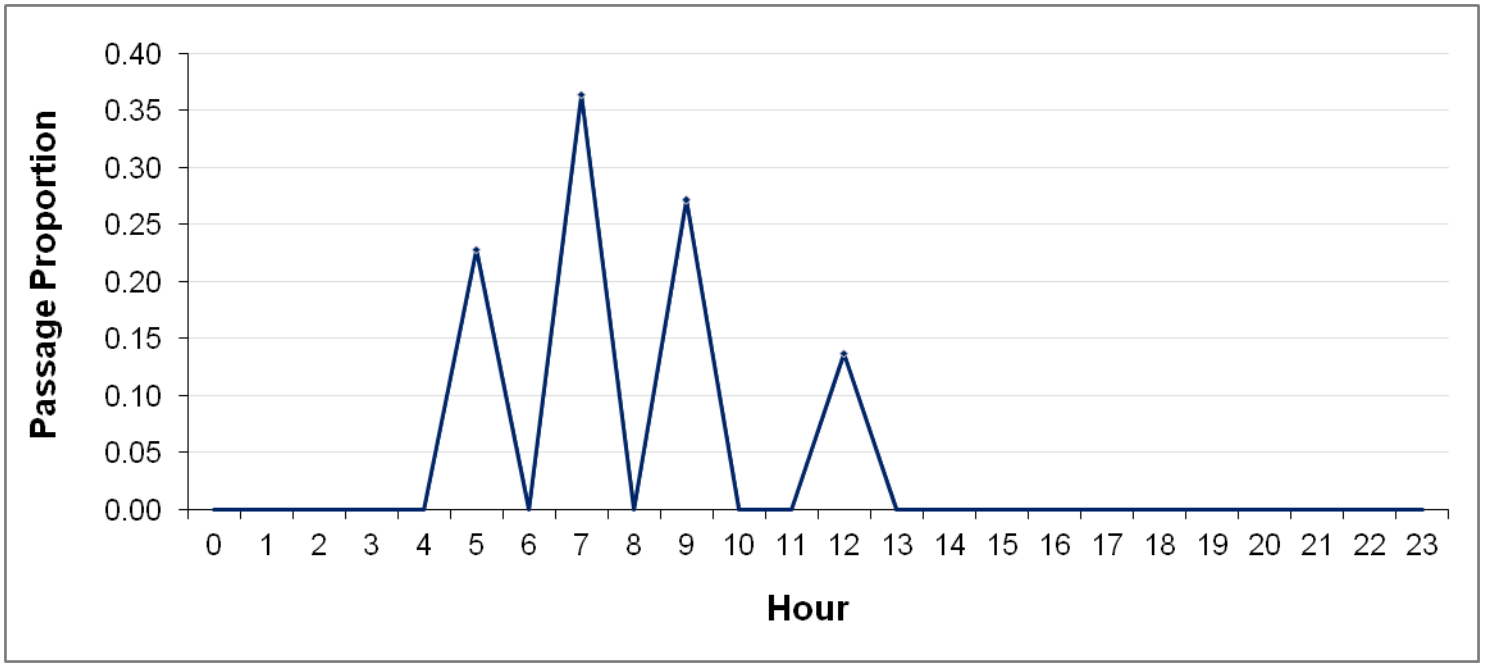
- Total fish passage was highest at Main Unit 18 (38 targets). Main Unit 5 passed the second highest number (16) and Main Unit 1 passed 8 fish.
- *Main Unit 8, which typically passes fish in the fall and spring, was offline for most of this study period.*



Pacific Northwest
NATIONAL LABORATORY

Diel Distribution

- Fish passage occurred during morning periods. Passage did not occur during the afternoon or nighttime.



Pacific Northwest
NATIONAL LABORATORY

Results: Period 3

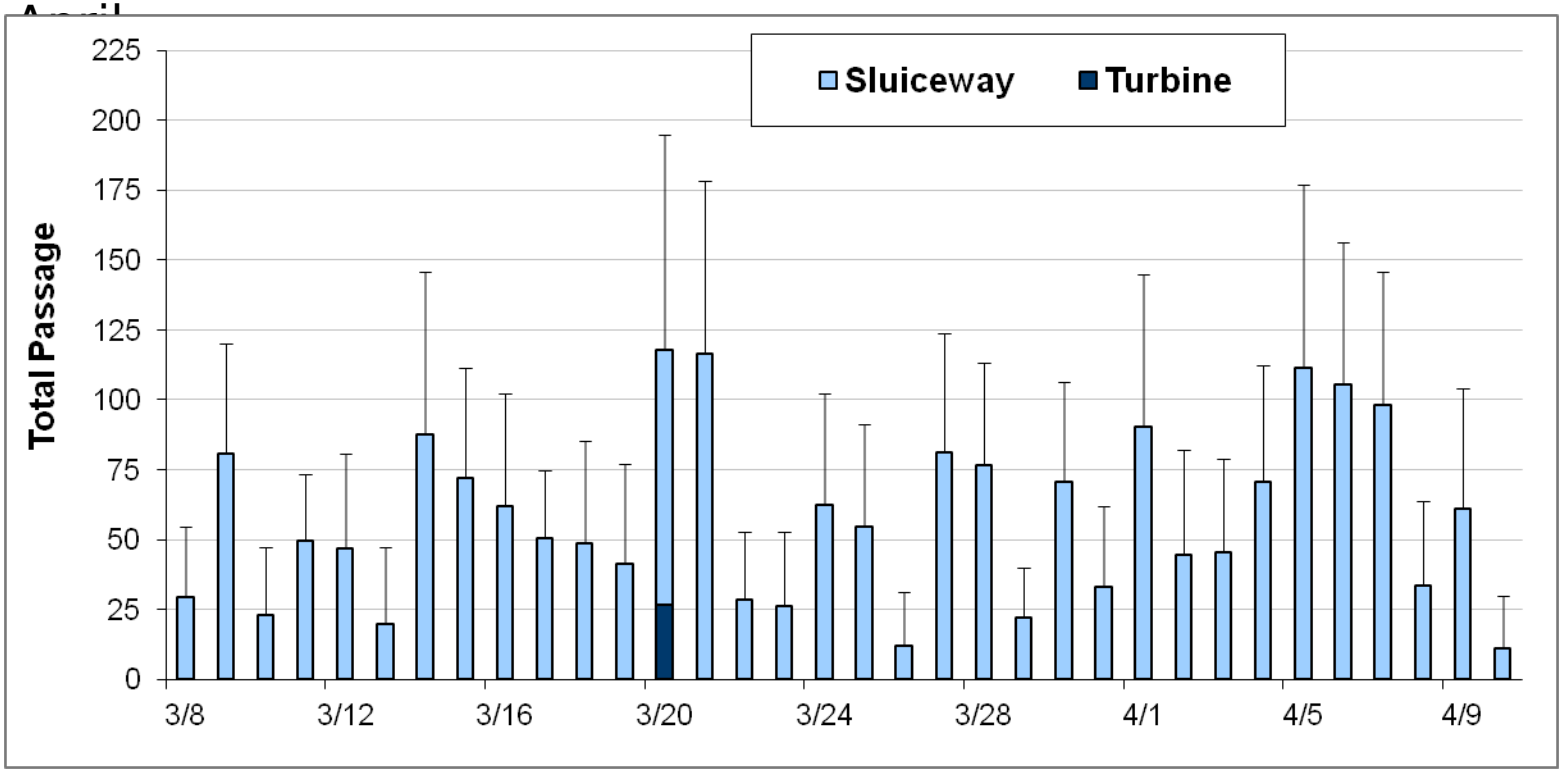
Spring: Sluiceway and Turbines

(March 8 – April10, 2010)

Pacific Northwest
NATIONAL LABORATORY

Passage Rates and Run Timing

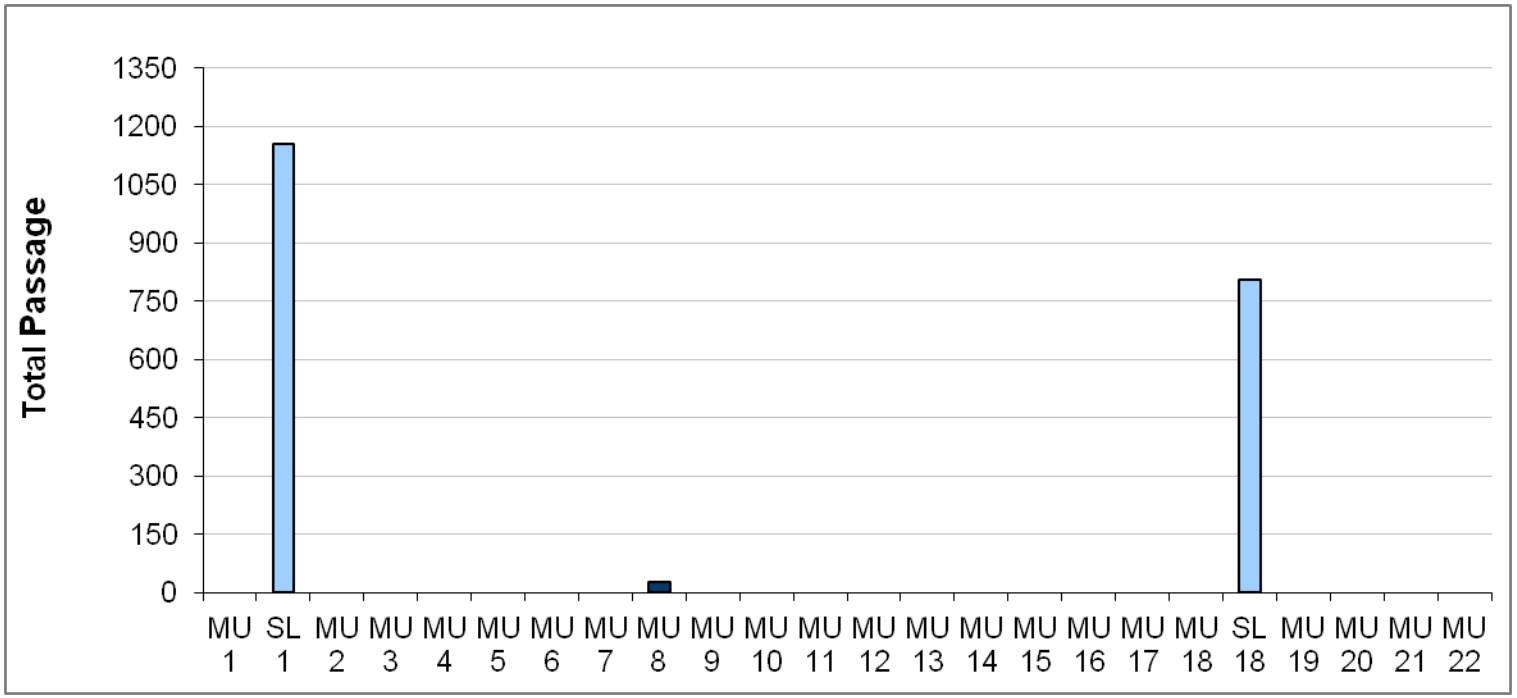
- 1,985 ±234 (95% CI) kelt size targets passed the sluiceway and PH intakes. Daily average of 58 targets.
- 1,958 (99%) passed through the sluiceway and 27 passed through the PH.
- Run timing peaked twice, once on March 20/21 and again in early April.



Pacific Northwest
NATIONAL LABORATORY

Horizontal Distribution

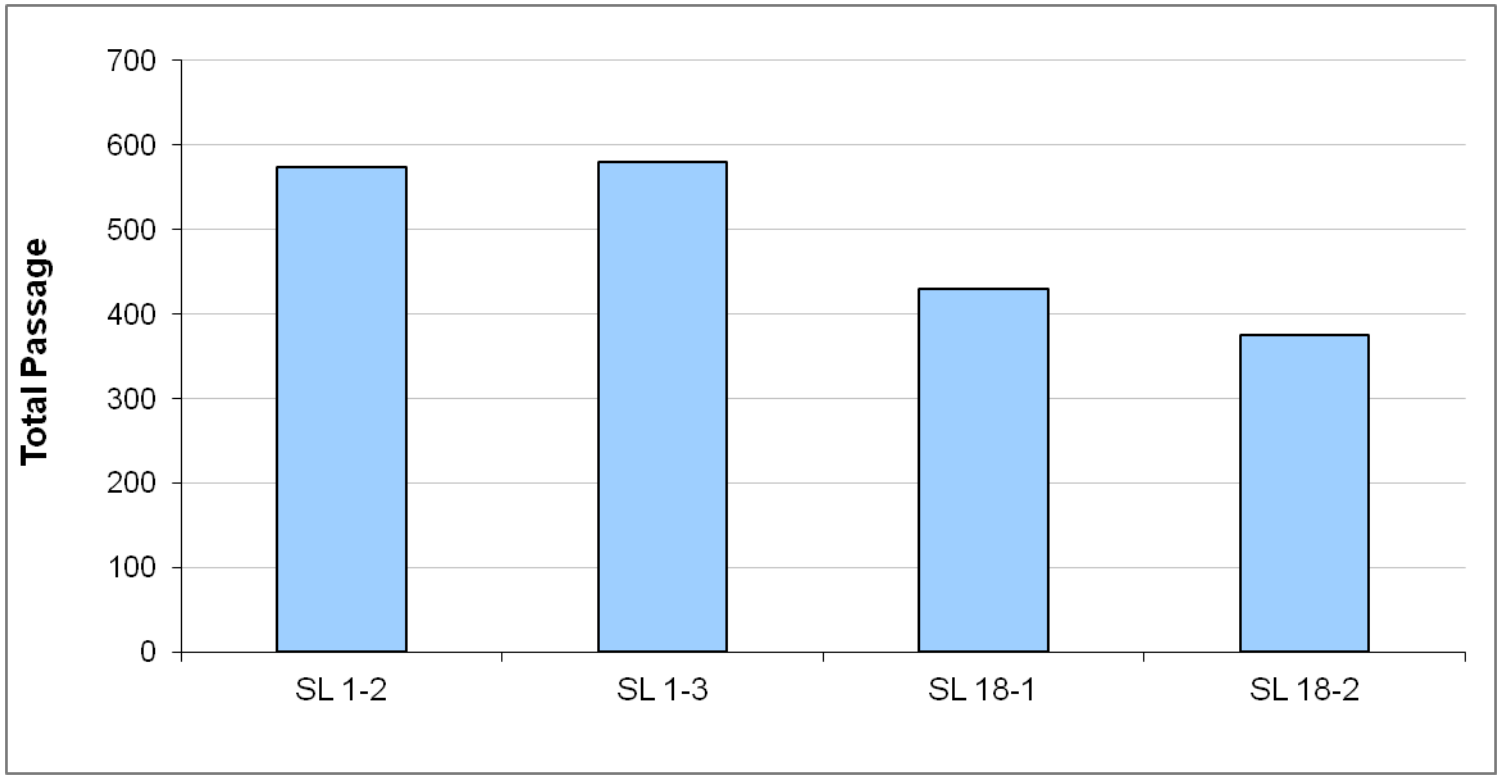
- Total fish passage was highest at Sluice 1 (1,153 targets). Sluice 18 passed the second highest number of fish passing (805) and a small number passed through powerhouse intake unit 8 (27).



Pacific Northwest
NATIONAL LABORATORY

Horizontal Distribution – Sluice Entrances

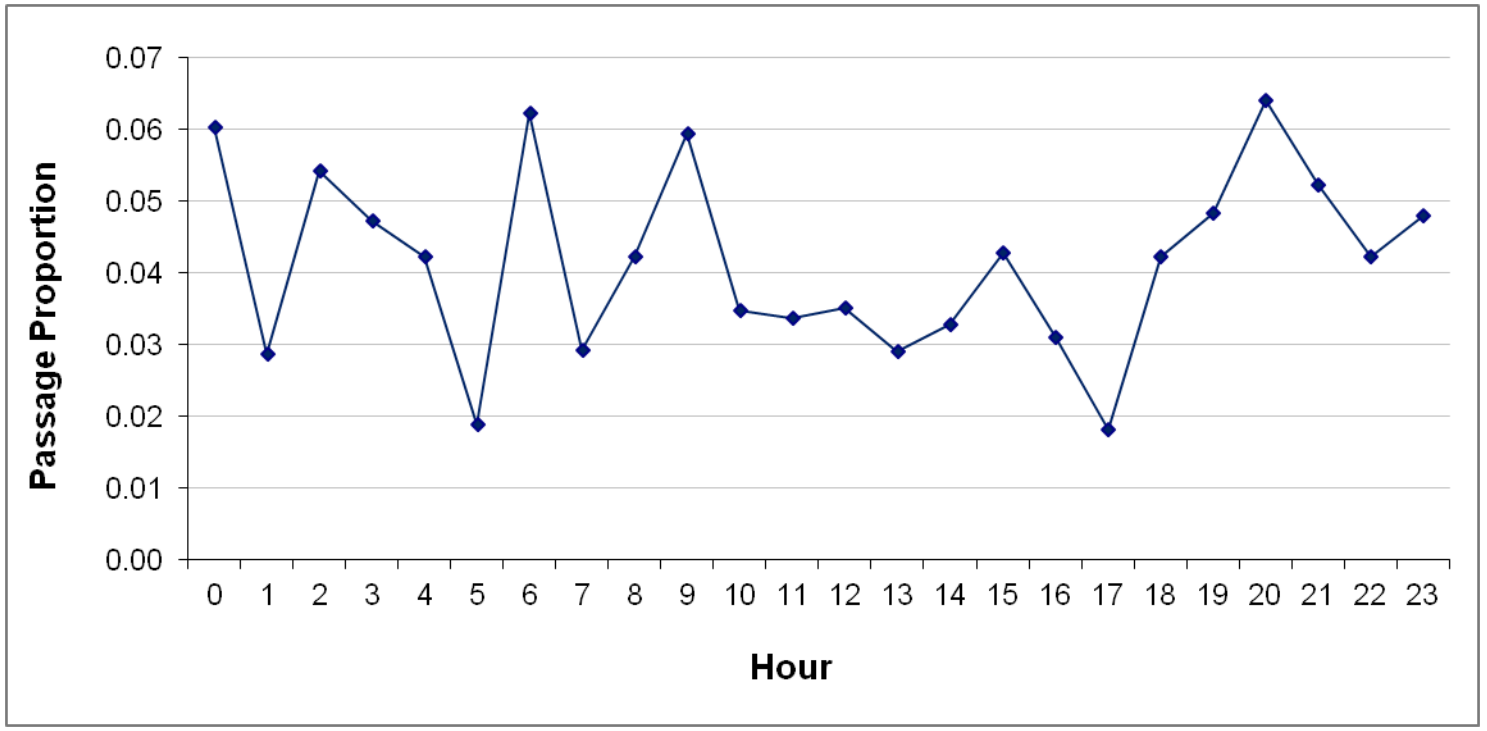
- For individual sluice entrances, SL 1-3 passed the highest number of fish (579 targets), followed by SL 1-2 (574). SL 18-1 passed 430 fish and SL 18-2 passed 375 fish.



Pacific Northwest
NATIONAL LABORATORY

Diel Distribution

- Diel distribution was highly variable and indicate steelhead targets were passing the dam at all times of the day.



Pacific Northwest
NATIONAL LABORATORY

Summary of Key Findings

- Period 1: Fallback of overwintering summer steelhead occurred throughout the 45-day study period. A total of 879 ± 165(95% CI) adult sized steelhead targets passed through the sluiceway and powerhouse turbine intakes. 92% of the total fish passed though the sluiceway. Run timing peaked in early December.
- Period 2: A total of 62 ± 40(95% CI) adult sized steelhead targets passed through the powerhouse turbine intakes during the 82 day period. All fish passed between mid January and February.
- Period 3: Downstream passage of early out-migrating kelt and overwintering summer steelhead occurred throughout the 34-day study period. A total of 1,985 ± 234 (95% CI) steelhead targets passed through the sluiceway and powerhouse intakes. 99% of the total fish passed through the sluiceway. Run timing peaked twice, once on March 20/21 and again in early April.

Summary of Key Findings

- For the two Sluiceway and Turbine study periods, horizontal distribution data indicated Sluice 1 is the preferred route for adult steelhead falling back and out-migrating kelts through the dam.
- Diel distribution for the two Sluiceway and Turbine study periods was highly variable. The lack of a clear pattern suggests that fish are passing at all times of day.
- Diel distribution for the Turbine only study indicated fish passage occurred only during morning periods; passage apparently did not occur during afternoon or nighttime

Passage Summary

- During fall, fallback rate at the turbines was twice that of winter and high at the sluiceway (approximately18 fish/day).
- During winter, fall back through the turbines was low at less than 1 fish/day during the 82-day period.
- During early spring, passage rates through turbines were low (< 1 fish/day); however, passage rates at the sluiceway were high (58 fish/day).

Study Period	# of Days	Turbine	Sluiceway	Total Passage	Turbine # Fish/Day	Sluiceway # Fish/Day	Total # Fish/Day
Nov 1 – Dec 15	45	75	804	879	1.67	17.87	19.54
Dec 16 – March 7	82	62	N/A	62	0.75	N/A	0.75
March 8 – April 10	34	27	1,958	1,985	0.79	57.59	58.38
Total	161	164	2,762	2,926			

Passage Summary 2008/2009 and 2009/2010

- For the 2008/2009 study, 3,556 adult steelhead targets passed the dam during the two study periods combined (11/1/08 – 12/15/08 and 3/1/09 – 4/10/09).
- For the 2009/2010 study, 2,926 adult steelhead targets passed the dam during all three study periods combined (11/1/09 – 4/10/10).

	Sluiceway		Turbine Units		Total	
Study Years	2008/2009	2009/2010	2008/2009	2009/2010	2008/2009	2009/2010
Nov 1 – Dec 15	1,704	804	86	75	1,790	879
March 1 – April 10	1,673	1,958	93	27	1,766	1,985
Total	3,377	2,762	179	102	3,556	2,864

Conclusion

- The results of this study indicates support for operating the sluiceway for steelhead fallback through December 15, closing it during winter, and opening it again on March 1 for adult steelhead moving downstream at The Dalles dam.